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The construction of frameworks in learners' thinking: conceptual change and threshold concepts in economics.

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Abstract

This review examines the value of the Framework Theory of Conceptual Change for making sense of teaching and learning in economics. This theory encourages us to consider learning economics as a process of changing from naïve to disciplinary conceptions. The paper reviews evidence of the nature of naïve conceptions in economics and the challenges that learners face when trying to construct more sophisticated ways of thinking. The review identifies synergies between the framework theory of conceptual change and the literature on threshold concepts which can provide a useful theoretical basis for curriculum design and teaching.

Key words

Conceptual change, threshold concepts, learning economics, hybrid conceptions.

Highlights

Comparison of the Framework Theory of Conceptual Change and the Threshold Concepts perspective highlights potential for development in both approaches.

In tandem, these two approaches can advance understanding of the construction of frameworks in learners' disciplinary thinking.

Evidence of emerging economic understanding supports the idea of 'hybrid' conceptions put forward by the Framework Theory of Conceptual Change, extending its relevance beyond mathematics and physical science.

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Introduction

This paper presents a conceptual change framework approach to learning and teaching economics. This approach has several hallmarks. It focuses primarily on *what* is to be learned (viewing learning processes and teaching strategies through this lens). This may be contrasted with approaches to teaching and learning derived from the information processing tradition (e.g. Carrasco-Gallego, 2017). It identifies different ways in which economic phenomena may be understood. Teaching should therefore focus on the *change* that learners have to make from one conception to another. Teaching does not focus simply on the characteristics of a textbook definition. A focus on conceptions can be contrasted with a focus on students' knowledge and attitudes (Parsons & Mamo, 2017). The framework theory of conceptual change also suggests that any particular way of understanding a phenomenon is derived from a framework of thought. Any conception, whether developed through everyday experience or scholarly thought makes sense within a given framework. A learner who does not understand the scholarly framework may simulate understanding of a particular idea, but the teacher should not be fooled. Finally, this approach portrays learning as a transition from conceptions that are framed through everyday experience towards conceptions that are framed by a coherent body of scholarship. It suggests that along the way the learner develops 'hybrid' conceptions which combine aspects of the everyday and scholarly conceptions.

Whilst the literature on conceptual change commonly speaks of *a* scientific framework, this paper suggests that scholarly framing of economic conceptions is better understood in terms of threshold concepts. We may speak of 'mainstream economics', but learners do not need to understand the entire framework of mainstream economics to develop a 'mainstream' economic understanding of each phenomenon. There are 'sub-frames' within the overall schema, which will be referred to here as threshold concepts. Understanding a threshold concept allows students to understand particular phenomena within the sphere of this threshold concept and that is often taken as sufficient in undergraduate economics. This way of thinking about the structure of the subject treats the framework of 'mainstream economics' as composed of the interlocking sub-frames of a set of threshold concepts. When a learner develops an understanding of a further threshold concept in economics, they create the possibility that they will subsequently revise their understanding of any threshold concept they had already grasped (Davies & Mangan, 2007).

The paper begins by introducing the framework theory of conceptual change which was developed from the idea that Kuhn's theory of the development of scientific thought might yield useful insights for understanding students' learning. This is followed by a review of evidence about 'everyday' thinking about economic phenomena. Google scholar was used to search for literature since it includes a wider range of sources than search engines such as Psychinfo. The search terms were 'Learning economics' AND 'conceptual change'. This search identified a number of studies that were conducted outside the conceptual change tradition, but which nevertheless provided valuable evidence for this review. The next section switches attention to scholarly conceptions in economics and the ways in which these conceptions are framed. Since the framework theory of conceptual change was inspired by Kuhn's theory of the development of scientific thought, this section offers a short summary of the development of economic thought in relation to price and trade. This section is used to examine what it means to refer to 'a scholarly conceptual framework' in economics. It presents a case for regarding a scholarly framework in economics as an interlocking set of critical ideas rather than a single framework that must be grasped in its entirety or not at all. This insight is

one of the contributions of the paper since the application of the framework theory of conceptual change in social science is still in its early days and previous literature has referred to 'a (single) framework'. This section also offers two more contributions: how an 'interlocking sub-frames' view of conceptual change recognises differences between the structure of social science and physical science and an account of what we know about difference between everyday and scholarly economic conceptions and stepping stones between one and the other.

Since the paper aims to show how threshold concepts provide a useful way of understanding this 'interlocking sub-frames' view of a framework for scholarly understanding in economics, the next section summarises the threshold concept idea and its application in learning and teaching economics. This is followed by a discussion that highlights four critical implications of this analysis for teaching and learning in economics. The final section offers some conclusions for research and practice.

1. Frameworks and conceptual change

The conceptual change theory of learning was prompted by Kuhn's (1962) theory of paradigm change in the history of scientific thought. It borrowed the idea that conceptions of the particular tend to be resistant to change insofar as they make sense within the context of an overarching way of thinking. This idea has big implications for learning and teaching. The framework theory of conceptual change (Vosniadou, 2013) has three main principles. First, everyday (or naïve) thinking is framed by a common-sense way of seeing the world. Second, conceptual change (from naïve to scientific conceptions) typically involves a shift in beliefs about nature of the world (ontology) and a shift in how this world may be known (epistemology) (Chi, Slotta, & De Leeuw, 1994). Scientific understanding changes through ontological categorical shifts (e.g. from explaining osmosis in terms of intentional movement of a body of coloured liquid (behaviour of an entity) to explaining osmosis in terms of random movement of molecules (process)). Conceptual change involves an epistemological shift such that 'how things really are' is different from my direct everyday experience. Third, conceptual change is a slow process in which fragmentation and misconceptions may be created. As learners grapple with the challenge of making sense of how a scientific understanding is presented to them they develop hybrid conceptions which try to reconcile elements of their naïve thinking with a scientific conception. Finally, conceptual change may be seen as *creating capacity* to think about the world using the frame provided by a discipline. An individual may switch between frames of reference according to their reading of the situation in which they are being invited to express their ideas (Carravita & Halldén, 1994).

This account focuses on the challenges created by shifting from an everyday framework to a scientific framework. Vosniadou (1994) illustrated these challenges through evidence of school students' conceptions of the shape of the earth, the day/night cycle, force and heat. She noted that Newtonian physics framed scientific conceptions of the shape of the earth, force and heat. This raises a few questions for a social science like economics which does have a well-established body of mainstream theory which is taught to undergraduates around the world. First, what would it mean to speak of a conception being framed by 'economic theory'? Mainstream economic theory was gradually assembled over a long period and it remains contested. Even if the idea of a 'scientific framework' could be transposed into the analysis of learning economics, what would be the relationship between different parts of the framework (as in different laws in Newtonian theory)? Framework theory

accounts of conceptual change emphasise ontological differences between everyday thinking and scientific thinking. Do we find a similar ontological cohesion in economics? If so, how does the learner develop such an all-encompassing framework? By analogy, once a learner has developed a conception of the shape of the earth or force or heat that is scientifically framed, what are the implications for further learning in science? Some researchers (e.g. Caravita & Hallden, 1994; Tiberghien, 1994) have suggested three rather than two structural levels in their depictions of conceptual change. This review of research suggests another view of the framework structure of scholarly thought: an interlocking structure of sub-frames which can be referred to as threshold concepts.

Moreover, it is possible that shifts from everyday thinking to disciplinary thinking not the same in physical and socio-economic settings. The processes described by physical science would still occur if there were no humans. But socio-economic processes have been created by humans. And they change as a consequence of human experience and thinking. This has consequences for the way in which everyday and scholarly thinking are framed. Everyday thinking is powerfully affected by what comes to be accepted as a normal way of organising society. Powerful discourses create stories not only about how things are but also about how things ought to be (Foucault, 1971). One powerful scholarly discourse in mainstream economics is that the subject addresses 'how the economic works', offering 'positive' analysis that abstracts from values. Yet economists continually offer prescriptions for how governments, organisations and individuals *should* act. When students are learning economics they are invited to change their conceptions not only about what has been but also about what should be in the future.

Finally, reflecting on structural change in learning through Kuhn's account of the progress of knowledge in physical science has particular resonance for the threshold concept discourse. His philosophy of science focused on shifts from one scientific conception to another. The literature on conceptual change has borrowed this idea to consider change from *everyday* to scientific conceptions. However, this begs the question of what it means to say that a student is now using a *scientific* conception. When conceptual change researchers write that a school student has developed a scientific conception of force do they mean that this student cannot improve their conception? When a school teacher judges that a student has 'understood' supply and demand, does this mean they have nothing to learn about supply and demand as an undergraduate? A view of the structure of scholarly conceptions in terms of interlocking sub-frames (threshold concepts) overcomes the problem of implying that a school student has a complete understanding of an economic phenomenon. Kuhn's philosophy of science is arguably most salient when considering change from one scholarly conception to another. This idea is explored later in the section on threshold concepts.

2. Naïve or everyday economic reasoning

This section briefly reviews six characteristics of 'everyday' thinking that can be described as naïve from the perspective of mainstream economics. The existing body of research is modest in scale and, therefore, this summary should be interpreted as indicative rather than conclusive. These characteristics are then reconsidered in the light of the alternative frameworks theory of conceptual change: what do these characteristics tell us about the framing of naïve economic understanding and

how might a naïve framework be formed? The section focuses on everyday conceptions of price and trade.

First, everyday reasoning handles contexts in different ways when they would all be treated as examples of the same phenomenon by mainstream economic thought. A study by Pong (1991) found that high school students in Canada used different conceptions of price in response to price problems set in different contexts (different types of product) and also used different conceptions of trade in response to trade problems set in different contexts. Davies & Lundholm (2012) found that secondary school and university students in England used different conceptions of price when reasoning about whether different goods and services should be available for free.

Second, everyday conceptions describe variation in economic variables in binary categories (levels are big or small and changes are either up or down).. For example, one conception may highlight variation in demand whilst another may not. We may go one step further and ask ‘what form of variation is highlighted?’ For example, Pang & Marton (2005, p. 175) used the following utterance to illustrate a conception of price:

“Because of the bird flu crisis, many people were afraid of getting the H5N1 virus from live chickens. At the same time, live chicken hawkers also dared not buy much from the wholesalers. Thus, there were fewer live chickens in the market. However, the price did not rise but fell. As many people were scared and did not want to buy live chickens, although there were fewer chicken in the market, the price dropped instead”. [Utterance 1]

This account uses ‘many’, ‘much’ and ‘fewer’ to refer to variations in demand and supply. This way of handling the dimensions of variation is much less exact than the way in which they are handled in introductory economics. Variation in demand in response to price or some other factor is described in introductory economics in terms of a ratio between proportional changes:

$$\frac{\% \text{ change in quantity demand}}{\% \text{ change in price (or another factor)}} \quad [1]$$

Differences in descriptive precision have also been observed in secondary school students accounts of geographical phenomena. Davies (2002) categorised descriptions of geographical phenomena in the answers of 14 year-old students in national trial assessments as either (i) using binary categories (e.g. hot/cold); (ii) multiple categories (e.g. hot/warm/cool etc.); or (iii) continuous variables, whilst also noting some examples of using ratios between continuous variables of the form of expression [1] above.

Third, everyday reasoning about economic phenomena treats causation as uni-directional. Lundholm & Davies (2013) used utterance [1] to illustrate this point. The student explains price as a consequence of changes in supply and demand. However, the conception of supply and demand presented in introductory economics treats causation as reciprocal. Price affects quantity supplied and demanded and supply and demand affect price.

Fourth, everyday reasoning appears to view prices as being set by individual sellers. This can be observed in the readiness of students to describe price setting by an individual seller as ‘supply’ (e.g. Dahlgren, 2005; Marton & Pang, 2008; Durden, 2018). It can also be observed the difficulty that children have in reasoning about the difference between a case where there are many suppliers and a

case where there is only one (e.g. Thompson & Siegler, 2000; Leiser & Beth Halachmi, 2006). Each of these studies shows how learners may start to use the terms 'supply' to communicate their everyday conception of selling. The use of the term 'supply' in economics embodies the cost conditions that constrain the options for any seller wishing to enter the market. This issue may be considered in the light of incommensurability suggested by Kuhn's philosophy of science: terms have different meanings within different theoretical frameworks (Arabatziz, & Kindi, 2013). However, learners do not face the same problem as scientists. In this instance, learners face the challenge of ascribing meaning within their existing framework of thought to a word that was developed to define a phenomenon that was given its shape within a theoretical framework by scholars within a discipline.

Fifth, everyday reasoning treats exchange as being a 'zero-sum game'. This is illustrated in a study of high school students (Pong, 1991) who were posed questions about gains from trade. Some responses to questions were categorised as 'zero-sum' (one person's gain from trade must be balanced by someone else's loss). Other responses were categorised as 'win-win' (both parties to the trade benefit). The 'zero-sum game' perspective features strongly in some theories in social science. It is expressed, for example, in arguments about 'credentialism' (e.g. Collins, 1979) and 'positional goods' (e.g. Marginson, 2006). This perspective treats the benefits from education as purely relative: if I get more education than you it helps me to position myself to secure a larger slice of what society offers. My gain is necessarily your loss. This idea also appears in everyday attributions of unemployment to immigration (Davies, Howie, Mangan & Telhaj, 2002). It is also expressed by politicians and others in the public domain when using similes such as 'cutting the cake' or 'the household budget' to explain the implications of government spending decisions (see for example, McCarthy, 1986).

Sixth, economic outcomes are believed to reflect actors' intentions. This has been observed in young people's views of pollution: environmental damage is inflicted by industrialists who (unlike me) don't care. Leiser & Aroch (2009) also reported evidence of a belief that 'good begets good' in a study of (non-economist) undergraduates' beliefs about relationships between macroeconomic variables.

From the perspective of mainstream economics, everyday reasoning can look like knowledge in pieces (DiSessa, 1988). Where mainstream economics sees a single class of price problems, everyday thinking seems to see a disparate set of problems that need to be understood in different ways. Constructing variables as simple binary alternatives and treating causation as uni-directional are not obviously derived from a common framework.

Nonetheless, we can see what a framework for everyday reasoning in economics might be built from. Everyday experiences of transactions (which increase in breadth with maturity) provide a basis for a developing personal theory of exchange (Schug & Lephardt, 1992). Consumers experience transactions with individual providers, rather than a market. They experience transactions as one-shot exchange rather than interactions between markets. We can also infer ways in which everyday reasoning seeks to go one step beyond personal experience. Metaphors from everyday life (like sharing a cake or preparing a household budget) are used to make sense of patterns of relationships well beyond personal experience. 'Scientific' language (such as 'supply') is appropriated to describe everyday experience. Since conceptual change interprets this kind of behaviour in relation to a transition from an everyday to a scholarly conception mis-using scholarly language may be labelled as a form of 'hybrid conception'. This term conveys a sense of a transition which is missing from label

'mis-conception' which is often used to refer to ways of thinking that have a rationale that is at odds with scholarly thought.

4. The development of economic thought

This section offers a brief review of developments (or revolutions?) in economic thought about price and trade. The questions here are what does a 'scientific framework'ⁱ for economic understanding look like and how might it be formed? Of course, conceptual change theory does not suggest that the development of individual conceptions follows a similar sequence to the development of disciplinary thought. However, we need to understand what it means to talk of a 'scientific framework' and we also need a reasonable account of how a scientific framework might emerge in an individual's understanding. Reflecting on the history of disciplinary thought might shed some light on these questions. For brevity, the following account is expressed primarily in terms of 'concepts', although it is taken for granted that the discipline is a way of 'thinking *and* practising': ideas about the world entail certain ways of forming and analysing problems and the practice of economics has been instrumental in forming ideas about the world.

At the end of the eighteenth century Adam Smith (1776) developed an explanation of *market* prices. His theory offers an account of what he called 'the natural price': where price will settle in a market given the pressures acting upon it from suppliers and demanders in this *and other* markets. It is fundamentally an idea about how a system works rather than an idea about individual transactions. Smith asked 'why does a musket cost more than a horseshoe?'ⁱⁱ He posed a system question, not an individual product question. Nonetheless, he treated markets for agricultural products and markets for manufacturing products as quite distinct (Backhouse 1985, Blaug 1997). He argued that whilst manufacturing prices were determined by costs of supply, agricultural prices were determined largely by consumers' willingness to buy as harvests varied. The shift of context from agricultural to manufacturing production alters the prominence given to buyers and sellers (i.e. the behaviour of the phenomenon is seen to alter according to its context) but this does not change the way in which the phenomenon itself is delimited.

It was only much later, after 1870, that economists developed a 'grand system' with a rigorous general theory of markets and their relationships with the pricing behaviour of individual firms (Shackle, 1967). At the heart of this 'grand system' lay a 'marginal revolution' (treating economic decisions as decisions made on marginal rather than average values) that was based on reasoning about relative rates of change in variables (as in expression 1, but expressed in differential calculus) (Landreth & Colander, 2002). One critical idea in this grand system was 'opportunity cost' (Von Wieser, 1914). This proposed that the value of anything reflected the value of what people were willing to give up in order to possess it. In the decade after the first World War the idea of opportunity cost was used to reconstruct the theory of international trade that had been developed by Ricardo a hundred years earlier (Ruffin, 2002, Samuelson, 2004). Ricardo had developed the theory of comparative advantage which explicitly denies a zero-sum game in international trade. The history of economic thought is punctuated by the emergence of transforming ideas that have gradually been integrated into a system of thought.

Historians of economic thought (e.g. Blaug, 1975; Leijonhufvud, 1976; Backhouse, 1994) have tended to be somewhat sceptical of using Kuhn's paradigms to describe change in the discipline and they have found Lakatos' (1970) 'methodology of scientific research programmes' more attractive. This

could, of course, simply be that economists like to think of their discipline and its development as more rational than that implied by Kuhnian analysis. It may also reflect differences between physical and social science which have made economists sceptical of the value of using explanations of the history of science to make sense of the history of economics. One enduring argument has been that the object of study in social science is a moving target: the causal mechanisms creating societies do not remain the same. Moreover, these mechanisms and their activation are influenced by developments in social science. The processes which led to the financial crash of 2008 as well as the responses of governments to the crash were products of ideas as well as events (Davies, 2015). It could also be that social science is at an earlier stage of development and has been engaged in 'normal science' in the context of its first paradigm (Wallerstein, 2001; Dow, 2007).

Moreover, whilst economists have been willing to describe changes in the discipline as 'revolutions', there has been little agreement about what has constituted a paradigm in economics (Drakopoulos, & Karayiannis, 2005). Historians of economic thought have preferred to view revolutions in terms of integration of powerful ideas, rather than the overthrow of one idea by another (Shackle, 1967; Blaug, 1975; Drakopoulos, & Karayiannis, 2005). The earlier account of the development of economic thought about price and trade between 1776 and 1930 may be understood in this way. This still leaves a question about the processes through which this integration took place. The summary of Nersessian (1992) provided by Arabatziz & Kindi (2013, 356) seems to provide an apt description: 'drawing analogies, constructing visual representations, forming idealizations and abstractions and inventing thought experiments'. These processes reformulated the nature of economic problems whilst incorporating rather than completely replacing earlier frames of understanding.

This section concludes with some reflections on (i) the contrast between the earlier account of naïve understanding of economics and the account of economic thought provided in this section; (ii) what it means to speak of a 'scientific framework' of economic thought and (iii) what might be involved for an individual learner in constructing and using a scientific framework of economic thought.

Table 1 summarises differences between everyday economic reasoning and the economic reasoning developed during the period 1776 and 1930 that provides the basis for standard introductory economics textbooks. When placed alongside each other there appears to be a contrast between everyday reasoning framed in the context of discrete personal experiences and disciplinary reasoning framed by a sense of a self-co-ordinating system of economic relationships. A 'self-co-ordinating system' can neither be seen nor its *systemic* processes experienced. It is the product of thought experiments aiming to make sense of economic activity as a whole. The disciplinary understanding can only be seen when using the tools and language developed by the discipline. Perhaps there is an echo here of the difference between understanding the shape of the earth as flat, on the basis of personal experience, and understanding the shape of the world as spheroidal on the basis of the evidence generated through the application of scientific reasoning (Vosniadou & Brewer, 1992).

Table 1 about here

However, the framework of thought depicted in the right hand side of Table 1 did not come into being as a complete entity at one point in time. It developed over 150 years. Points within that development were experienced as profound changes in thinking by economists at the time and have been labelled subsequently as 'revolutions'. The work of academic economists was framed in

different ways throughout those 150 years even if current introductory textbooks present that framework as a single coherent entity.

As students try to understand disciplinary ways of thinking (the right hand side of Table 1), they develop hybrid conceptions in which they try to incorporate elements of disciplinary thought within their everyday thinking. Research on conceptions of price (e.g. Marton & Pang, 2003, 2005; Davies, 2011; Durden, 2018) has revealed common types of hybrid conception. Much of this research has interpreted differences between students' conceptions as steps towards understanding a model of price as an outcome of supply *and* demand. This is an important part of the story, but 'liminal space' between everyday and disciplinary reasoning is a complex and challenging terrain for the learner. The disciplinary model of price also assumes that price is determined in markets and that causation is reciprocal. Students may answer some questions correctly when they have got part of the story, but that does not necessarily mean they are now 'thinking like an economist'.

What does this suggest for a framework theory account of the development of economic understanding? First, we have a challenge in deciding what constitutes a disciplinary framework. Each of the six characteristics on the right hand side of Table 1 shares in a common ontology: economic phenomena are outcomes of market interactions in an economic system. This suggests that, collectively, they embody a common theoretical framework. Yet we can also observe each of these ideas independently framing conceptions of economic phenomena and we can also observe understanding of each of these ideas being changed when further dimensions of the overall framework are incorporated into a learner's thinking. There is a mutual interdependence between understanding each of the six characteristics on the right hand side of Table 1 and coming to understand the overall framework that binds them together. A journey of learning that travels this road will place strong demands on learners' epistemological beliefs. They must believe that disciplinary knowledge is provisional or they will lose faith in their teachers. This view of the framing of conceptual change suggests more than one level of framing: an overarching disciplinary 'way of thinking and practising' which frames, and is constituted through interlocking sub-frames that, in turn, frame ways of thinking about particular phenomena.

5. Threshold concepts: a brief summary

The idea of threshold concepts is still fairly recent and it remains in a state of development. It emerged from lecturers' accounts of students' learning in higher education (Meyer & Land, 2003, 2005; Davies & Mangan, 2007). These early accounts of threshold concepts suggested they possessed five characteristics: transformative; integrative; irreversible; boundary setting and troublesome. Later work has extended this list of characteristics. Baillie et al. (2013) suggested additional characteristics which distinguish between elements that were previously grouped under the term 'transformation': a change in the learner's sense of identity ('reconstitution') and capacity to meaningfully participate in the high-level narratives of the subject ('discourse'). Barradell (2013) noted that some writers have suggested that a threshold concept might possess some but not all of these characteristics. This 'pick and mix' approach leaves the idea vulnerable to criticism (e.g. Rowbottom, 2007) that any one of these characteristics might be observed to some degree in *any* conceptual change. The alternative position (e.g. Davies & Mangan, 2007) is that threshold concepts are defined by a necessary combination of these characteristics and that this combination creates a critical point in a journey of learning. In this account, trouble in conceptual change is attributable to the challenge that the combination of

transformation, integration and boundary-setting may pose for learners' beliefs about the nature of economic knowledge and how they can be sure about what there is to know. This aspect of learning threshold concepts was expressed through the idea of liminality: self-awareness of being at a moment of significant change in learning. Accounts of 'liminal space' in learning emphasised loss of previous certainty in knowing and uncertainty about what was to come.

One advantage of an idea about teaching and learning that has been developed through accounts of practice is that it seems to 'ring true' to lived experience. This probably accounts for widespread adoption as a vehicle for describing teaching and learning in disparate subjects in higher education. Threshold concepts have been used to describe learning experiences in history, philosophy and English as well as mathematics, science and economicsⁱⁱⁱ. The idea of threshold concepts has been sufficiently open to enable a range of explorations that have been perceived as reflecting diversity in the nature of learning in different subjects. This raises the question of whether these explorations share a common theoretical base. Recent contributions from the authors of the idea have drawn on different sources of inspiration to answer this question. Baillie, Bowden & Meyer (2013) developed what they call 'the Threshold Capability Integrated Theoretical Framework' combining earlier work on threshold concepts with capability theory. This framework emphasises what individuals are able to do with their knowledge when faced with unfamiliar problems or circumstances. It explicitly positions threshold concepts within a theory of thinking *and* practice. Land, Rattray & Vivian (2014) interpreted liminality in coming to understand a threshold concept through semiotics: emphasising changing relationships between signifiers and the signified as learning occurs. This interpretation carries strong echoes of incommensurability in Kuhn's account of the philosophy of science.

The diversity in applications of the idea of threshold concepts and explorations of new theoretical directions illustrate the fertility and malleability of the idea, whilst also suggesting uncertain foundations. The premise in this paper is that reconsidering threshold concepts in terms of conceptual change has potential for insights in both directions: for threshold concepts in terms of theoretical foundations and for conceptual change in terms of a context for learning (social science in higher education) that has, thus far, received limited attention within the field.

6. Conceptual change in economics: threshold concepts and frameworks

This section draws upon each of the previous sections to develop a rough account of four propositions about the benefits for teaching and learning in economics of examining synergies between threshold concepts and the framework theory of conceptual change: (i) The nature of threshold concepts in economics and the challenges for learners are clarified; (ii) The development of a new framework in an individual's economic thinking is given a distinct form; (iii) Economic understanding develops as successive threshold concepts are integrated into a scientific framework; and (iv) 'Misconceptions' are generated as new threshold concepts are added to the learners' framework for understanding the discipline.

6.1 The nature of threshold concepts in economics and the challenges for learners and teachers are clarified

A first, obvious question about threshold concepts is how do you recognise them (Davies, 2006)? The framework theory of conceptual change suggests that an answer may be found in the history of disciplinary thought. A threshold concept should, in some fashion, re-frame ways of understanding a range of phenomena. The theories of supply and demand and opportunity cost have been regarded as

critical developments in the history of economic thought. Unsurprisingly, therefore, both have been suggested as ‘threshold concepts’ (Shanahan, Foster & Meyer, 2006; Davies & Mangan, 2007). However, recognition of these complex ideas as threshold concepts is made difficult by ways in which teachers as well as learners use the technical terms to refer to more simple ideas that bear limited correspondence to the ‘scientific’ understanding. For example, the idea of opportunity cost is often presented in introductory economics in the following terms: ‘If we have £20 we can spend it on an economic textbook or we can enjoy a meal in a restaurant’.^{iv} This statement falls into the category of ‘you can’t have your cake and eat it’: a classic everyday figure of speech. This is quite different from the idea that variations in price reflect the value, at the margin, of what people are willing to give up to obtain different products. This problem is highlighted in Land, Rattray & Vivian’s (2014) interpretation of threshold concepts which emphasises ways in which terms that have been developed to convey a new theoretical idea may be given a different meaning in everyday usage.

6.2 The development of a new framework in an individual’s economic thinking is given a distinct form

Conceptual change research has concentrated on movements from everyday thinking to thinking framed by the structure of scientific disciplines. The literature on threshold concepts offers insights into the challenges that learners face when trying to construct disciplinary frames in their thinking. This difference reflects the focus in most conceptual change research on younger learners and the focus of threshold concepts research on learning in higher education and the final years of secondary school. How does an individual develop a ‘scientific’ framework which will shape their thinking? Suppose we imagine the following:

Phenomenon A may be understood in terms of conceptions A_1 , A_2 , A_3 or A_4

Phenomenon B may be understood in terms of conceptions B_1 , B_2 , B_3 or B_4

Phenomenon C may be understood in terms of conception C_1 , C_2 , C_3 or C_4

In each case the X_1 conception is categorised as everyday thinking and the X_4 conception is categorised as scientific thinking, whilst conceptions X_2 and X_3 are hybrids reaching out from X_1 towards X_4 . Each of A_4 , B_4 and C_4 is framed by threshold concept T_1 . For example, suppose we consider ‘understanding price in terms of interaction between markets’ as threshold concept T_1 . Phenomena A, B and C might be each of ‘demand’, ‘cost (of supply)’ and ‘where prices are determined’. Everyday thinking conceptions typically include ‘when price goes up, demand goes down’ (A_1), ‘if a business produces more, the cost per item will fall’ (B_1) and ‘prices are set by businesses’ (C_1). T_1 presumes that the effect of price on quantity demanded is negative, whilst the effect of demand on price is positive and that these relationships should be understood in terms of proportional changes. T_1 presumes that the cost of supply will increase as quantity supplied in the market increases because it will become more expensive to secure the additional resources needed to increase supply and because new higher cost suppliers will enter the market. T_1 presumes that prices are set in markets. Developing understanding of demand from A_1 to A_4 is fairly unproblematic because the fundamental character of the phenomenon is retained (involving many buyers who prefer to spend less) as it is understood in more sophisticated ways. Developing understanding of supply is more challenging for learners because nature of the phenomenon and its behaviour are fundamentally changed: from a single seller to a market in which sellers may come and go and from a negative relationship between output and supply price to a positive relationship between output and supply price. This understanding is

related by the threshold concept to understanding of where prices are set: necessitating a capacity for the learner to switch between how matters look for the individual supplier and how they look for the market as a whole. Thinking of price in terms of this threshold concept requires developments in conceptions of subsidiary phenomena (A, B and C) which only make sense when the whole is viewed in terms of the threshold concept (Davies, 2012). The idea of ‘hybrid conceptions’ from the conceptual change offers some landmarks to the teacher trying to support the journey of learners through ‘liminal spaces’.

The literature on students’ understanding of price (e.g. Pong, 1991; Thompson & Siegler, 2000; Pang & Marton, 2003, 2005; Leiser & Halachmi, 2006; Davies & Lundholm, 2012; Ignell, Davies & Lundholm, 2017) provides ample evidence of different conceptions of these phenomena and of improvements in conceptions of these phenomena which move learners closer to the T_1 conception without having reached it. What we see in this body of research is the uncertain development of ways of delimiting phenomena and explaining relationships between phenomena using terms such as price, supply and demand which have been developed by disciplinary thought as part of a systematic representation of economic relations (a threshold concept). Learners need to become familiar with using these categories and expressing relationships between these categories before they can make any sense of systematic view that has generated these ways of thinking. But understanding the phenomena through the systematic way of thinking necessarily reconfigures the categories and relationships through which they have approached the threshold concept.

6.3 Economic understanding develops as successive threshold concepts are integrated into a scientific framework
When we transpose the idea of a ‘scientific framework’ into the account of economic understanding presented in Table 1 we are faced with the question of whether each of the statements on the right hand side constitutes a framework or whether they collectively constitute a framework. We can observe each of the ideas in the right hand column of Table 1 emerging in the history of economic thought, with a number being heralded as some kind of revolution, yet they have also developed into a coherent whole such that the current meaning given to each of the ideas is different from how it first appeared. Davies & Mangan (2007) portrayed the development of undergraduates’ understanding of economics in a similar fashion. They suggested that ideas such as ‘price formation through interaction between markets’, ‘opportunity cost’ and ‘zero-sum game’ should each be regarded as threshold concepts. When any of these three ideas becomes embedded in a learner’s thinking it reconfigures ways of classifying phenomena and ways of understanding relationships between phenomena. Therefore, each of these ideas may be regarded as framing understanding. Nonetheless, when a learner embeds a second or third threshold concept in their thinking it will configure their understanding of the first threshold concept. This necessarily follows from the proposition that a group of threshold concepts may combine to characterise a way of thinking and practising - or overall framework - in a discipline.

6.4 ‘Misconceptions’ are generated as new threshold concepts are added to the learners’ framework for understanding the discipline

The framework theory of conceptual change treats ‘misconceptions’ as non-alignment between a conception and a framework. An everyday conception aligns with an everyday framework and is perfectly acceptable when that framework is consciously treated as the appropriate frame of reference. However, if the frame of reference is a scientific conception of the world then the everyday

conception will be out of alignment and new misalignments will be generated as learners attempt to incorporate scientific ways of thinking through 'hybrid' conceptions.

One type of misconception occurs when disciplinary terms are used to refer to phenomena as they have been constructed in everyday thinking. Describing the output of a single producer as 'supply' is a case in point, encouraging a misconception of the relationship between cost and output in the market. However, if we see development of understanding of a discipline in terms of an expanding frame of reference as further threshold concepts are incorporated in a structure of thinking then we raise the possibility that misconceptions will be generated at points of framework change as well as in the process of moving from everyday to scientific thought.

Conclusions

This paper has offered a perspective on learning economics that integrates the framework theory of conceptual change and the idea of threshold concepts. This offers something new to conceptual change theory: a model of how conceptual frameworks are constructed and how they interact. It also offers a new theoretical underpinning for the idea of threshold concepts. The claim of the paper is that this theoretical framing of learning economics offers a coherent basis for the design of curricula and for teaching strategies which should appeal to those interested in being able to offer a clear justification of their approach to teaching. Of course, the value of theorisation about learning depends on its implications for practice.

The implications for teaching economics follow from the idea that the quality of learning depends on the extent to which learners are constructing scholarly frameworks of thought at the same time that they are learning particular models and language. Teachers can simply hope that students will work away unprompted at organising their own thoughts in line with the frameworks of economic theory. However, conceptual change theory predicts that many students will be simply trying to accommodate what is taught into their everyday thinking, even when they appear to manipulate models in appropriate ways. There will be great pressure on lecturers to treat the resulting hybrid conceptions as 'the real thing': otherwise there will be too many failures. The threshold concept literature suggests that even when a scholarly framework starts to come into a student's view it will prove troublesome because it challenges the everyday framework the student has been using.

So what can lecturers do? First, they can regard their teaching as an act of seeking to *change* students' conceptions rather than focusing only on 'correct' versions of received ideas in the discipline. Experienced and effective teachers do take account of student 'misconceptions' they have encountered, but this can become more systematic if the accumulating research evidence is taken into account. Moreover, the framework theory/threshold concept account set out in this paper suggests that these 'misconceptions' are generated by the persistence in students' thinking of frameworks that are derived from their everyday thinking. Therefore, it is not just a case of being alert to the 'misconception': a bigger problem lurks behind. For example, a student may learn that when they draw a typical supply and demand diagram, the supply curve slopes upwards, whilst actually retaining an approach to price problems whereby supply is conceived in terms of 'bulk selling': price goes down when more is sold. The problem lurking behind here is trying to analyse a market (supply and demand) problem as a simplistic firm problem (in which there is no diminishing marginal

productivity). The student frames the problem in a totally different way to the way that is expected by the lecturer. They develop an ability to manipulate a (supply and demand) diagram whilst retaining an understanding of supply that contradicts what they have drawn. This is typical of a 'hybrid' conception.

Second, teachers can help students to become aware of these critical differences by highlighting alternative frameworks in their teaching. This involves contrasting everyday frameworks with scholarly frameworks: the difference between viewing price in terms of the decision-making of a single business and viewing it in terms of the behaviour of firms in markets or the difference between viewing trade as a zero-sum game or not. But it also involves contrasting alternative scholarly frameworks: both within and between paradigms.

Of course, current research only offers so much which can inform teaching and there is plenty of scope for discovering more about everyday economic thinking, the hybrid conceptions that students' develop and the challenges they face in developing scholarly frameworks of thought. This paper has mapped out something of what we know, but even in these territories of price and trade, there is much to be done to provide a more secure base for teaching and curriculum design. I hope that the paper will stimulate this activity.

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Table 1 Comparison of characteristics of everyday economic thinking and the economic understanding developed by the 'grand system' which is presented in introductory economics textbooks

<i>Characteristics of everyday economic reasoning</i>	<i>Characteristics of the 'grand system' of economic reasoning</i>
Reasoning about price specific to the product	All prices understood through the same model
Prices the result of the decision of business	Prices set in markets
Economic outcomes reflect intentions	Economic outcomes the product of systems and may not reflect intentions
Variation in variables described in binary terms or multiple categories	Relationship between variables describe in terms of ratios between change
Causation uni-directional	Reciprocal causation
Exchange is a zero-sum game	Exchange is not a zero-sum game because of system consequences

Notes

ⁱ Whether economics should be regarded as a 'science' remains a matter of debate. Colander (2004) has long argued the case for regarding economics as an art.

ⁱⁱ Smith (1776) used examples of products bought and sold in everyday life. These two products are used here for metaphorical effect.

ⁱⁱⁱ The preface to Land, Meyer & Flanagan (2016) claims that threshold concepts have been used to make sense of practice in 259 subjects in over 45 countries.

^{iv} From the website 'economics help' found at <http://www.economicshelp.org/blog/2177/economics/opportunity-cost-definition/>. Of course, it is incomprehensible that anyone should face a dilemma when choosing between a nice meal and an economics textbook.